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FLOOD INSURANCE STUDY

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CITY OF RICHFIELD, UTAH
SEVIER COUNTY

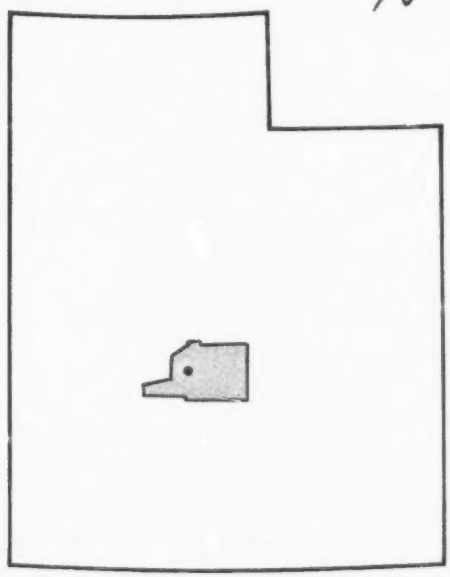

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TABLE OF CONTENTS

		Page
1.0	INTRODUCTION	1
1.1	Purpose of Study	1
1.2	Authority and Acknowledgments	1
1.3	Coordination	1
2.0	AREA STUDIED	2
2.1	Scope of Study	2
2.2	Community Description	2
2.3	Principal Flood Problems	4
2.4	Flood Protection Measures	5
3.0	ENGINEERING METHODS	5
3.1	Hydrologic Analyses	7
3.2	Hydraulic Analyses	7
4.0	FLOOD PLAIN MANAGEMENT APPLICATIONS	9
4.1	Flood Boundaries	9
4.2	Floodways	10
5.0	INSURANCE APPLICATION	10
5.1	Reach Determinations	10
5.2	Flood Hazard Factors	10
5.3	Flood Insurance Zones	11
5.4	Flood Insurance Rate Map Description	11
6.0	OTHER STUDIES	12
7.0	LOCATION OF DATA	12
8.0	BIBLIOGRAPHY AND REFERENCES	12

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TABLE OF CONTENTS (Cont'd)

Page

FIGURES

Figure 1 - Vicinity Map..... 3

TABLES

Table 1 - Major Floods Affecting Richfield..... 6
Table 2 - Summary of Discharges..... 8
Table 3 - Flood Insurance Zone Data..... 12

EXHIBITS

Exhibit 1 - Flood Insurance Rate Map Index
Flood Insurance Rate Map

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1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the City of Richfield, Sevier County, Utah, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in its efforts to promote sound flood plain management. Minimum flood plain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations at 44 CFR 60.3.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the State (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were performed by Rollins, Brown and Gunnell, Inc., for the Federal Emergency Management Agency (FEMA), under Contract No. EMW-83-C-1174. This study was completed in December 1984.

1.3 Coordination

Streams requiring detailed study were identified at a meeting attended by representatives of the study contractor, FEMA, and the City of Richfield in April 1983.

Requests for pertinent information were made to the U.S. Soil Conservation Service (SCS), the U.S. Army Corps of Engineers (COE), the U.S. Forest Service, the Utah Division of Water Resources, the Utah Department of Transportation, the Utah Water Research Laboratory, and Richfield.

Results of the hydrologic analyses were sent to Richfield, the SCS, and the State of Utah for review and comment. An intermediate

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meeting was held on November 9, 1984, with Richfield officials to review preliminary delineations of the floodway and flood boundaries. The city officials indicated that the maps appeared to adequately depict flood hazards, and no revisions were necessary as a result of this meeting.

The final community coordination meeting was held on November 4, 1985, and attended by representatives of FEMA, the study contractor, and the community. No problem concerning the results of the study were raised at that meeting.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated areas of the City of Richfield, Utah. The area of study is shown on the Vicinity Map (Figure 1).

The flooding sources studied by detailed methods were Cottonwood Creek and Dairy Canyon.

The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development or proposed construction through 1989.

2.2 Community Description

The City of Richfield is located in western Sevier County, in central Utah. The city is situated between the east slope of the Pavant Mountains and the Sevier River. Richfield is surrounded by the unincorporated areas of Sevier County. Nearby communities include Annabella, Central, Elsinore, and Monroe to the south, Glenwood to the east, and Aurora and Salina to the north.

The economy of the area is based mainly on agriculture and livestock production. Other industries include tourism, poultry, wallboard manufacturers, and service facilities. Richfield is the major city in the valley and is the county seat.

Richfield is located at the mouths of several canyons with intermittent streams that drain the Pavant Mountains.

Elevations range from above 10,000 feet in the upper portions of Cottonwood Canyon down to approximately 5,300 feet at Richfield. Vegetation in the area varies significantly with elevation, slope, and aspect. Aspen and conifer forests exist generally in the high elevations, juniper and sagebrush generally in the middle elevations, and sagebrush and desert grasses mainly in the lower elevations.

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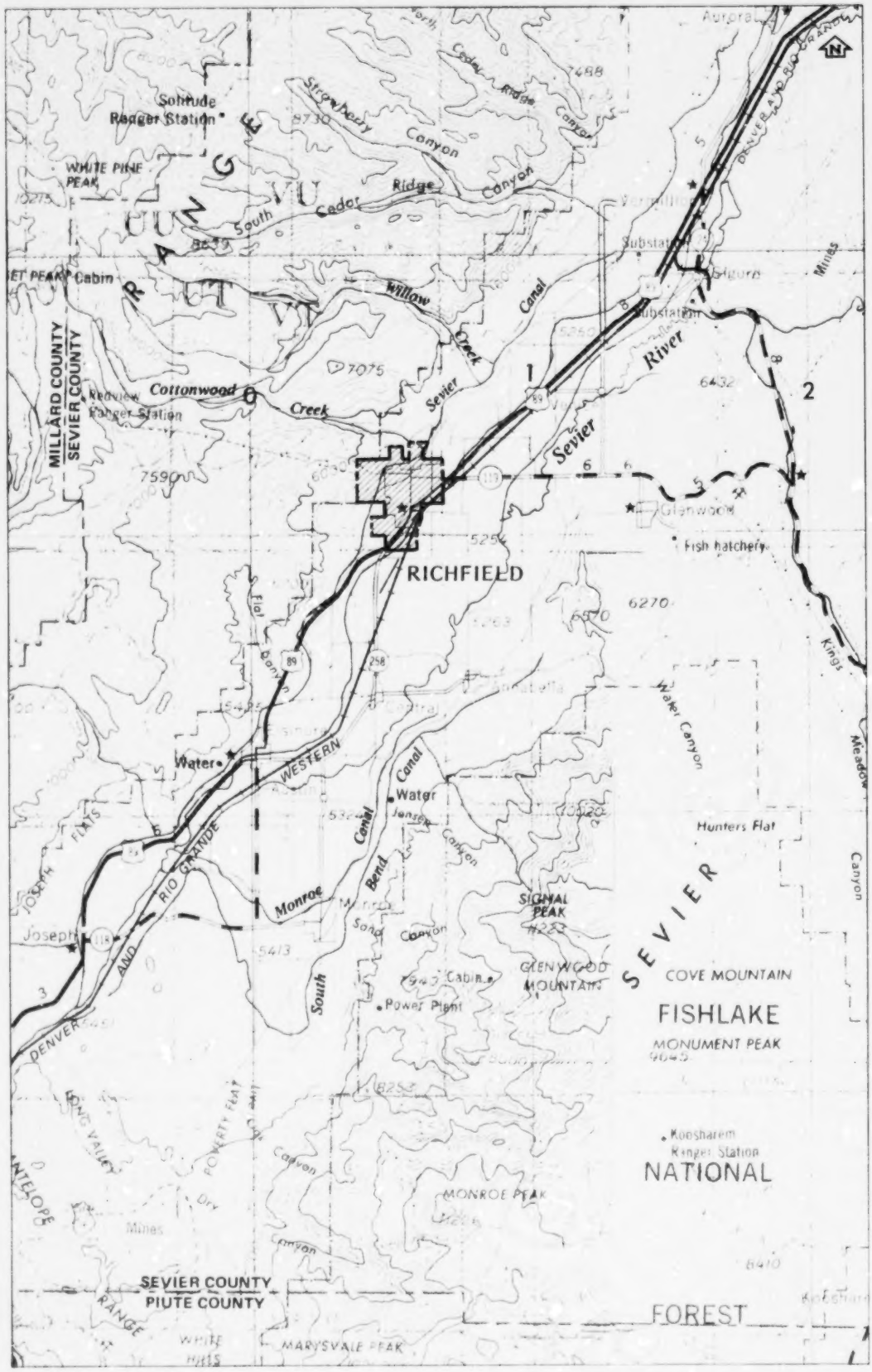

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Dairy Canyon and the lower portion of Cottonwood Canyon are steep and rocky and support only sparse vegetation. Soils are tight and runoff is rapid. Large alluvial fans have formed at the canyon mouths, attesting to the high debris load carried in floods from these canyons. Richfield is located on the lower portion of these fans.

New residential developments are occurring in the western portions of the city, some of which are subject to flooding from the Dairy and Cottonwood Canyons. The Richfield Hospital and a number of governmental offices have been built on the Cottonwood Creek alluvial fan near the canyon mouth.

2.3 Principal Flood Problems

Precipitation in the Richfield area originates from two major sources. Moisture-laden polar Pacific air entering the area from the west or northwest during the winter produces large general storms, which most often result in heavy snowfall in the upper elevations and either snowfall or moderate-intensity rainfall in the lower elevations.

The second major source of precipitaiton in the area arises from tropical airmasses entering from the Gulf of Mexico from the south and southwest during the summer. These airmasses cause high-intensity convective or cloudburst storms, which are augmented by the orographic lifting that occurs as the airmasses pass over the mountains.

Flooding in the Richfield area can result from either heavy spring snowmelt or from summer cloudburst storms. Spring snowmelt runoff from Cottonwood Creek in 1983 and 1984 caused substantial damage to two bridges and considerable erosion of the channel. However, infrequent cloudburst floods have a much greater potential damage in the Richfield area. Peak discharges from cloudbursts can be as much as 10 times greater than from snowmelt and can easily exceed the capacity of the existing channel. Floodwaters carry a large amount of mud, rocks, and debris, which make flow paths highly unpredictable, forming large alluvial fans.

The sources of frequent flooding in Richfield have been Dairy, Rulon Lind, Tank, and Cottonwood Canyons, having drainage areas of 1.24, 1.06, 0.75, and 20.0 square miles, respectively. This study considers only flooding from Dairy and Cottonwood Canyons.

The Sevier Valley-Piute Canal traverses the alluvial fans just above the City of Richfield, and has contributed to flooding. Floods have deposited debris and sediment in the canal, causing the canal to breach, thus adding to the flooding problem.

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Richfield has a long history of flooding, dating from the city's original settlement. However, records and flood descriptions are meager. The largest flood recorded for Cottonwood Creek occurred on August 6, 1967, and had an estimated peak discharge of 5,180 cubic feet per second (cfs) and an estimated return period of 250 years. This flood caused considerable damage, spreading mud and debris over a large area. The dates of the major floods affecting Richfield and the estimated peak discharges are given in Table 1.

2.4 Flood Protection Measures

Three studies (References 1, 2, and 3) have proposed that flood-control structures be built in the mouths of both Cottonwood Creek and Dairy Canyon. However, project costs were high and the proposed structures were never built. However, a diversion channel and a small debris basin have been built at the mouth of Dairy Canyon. The diversion channel has a limited capacity and will be ineffective during a major flood. Only the smaller, more frequent floods will be diverted into the debris basin.

The Utah Department of Transportation is presently designing Interstate Highway 70 between Cove Fort and Salina. The new highway will be built on the west side of Richfield and will cut across the alluvial fans built by Cottonwood Creek and Dairy Canyon. Flood-protection measures to be built in conjunction with the highway are being contemplated; however, no decisions concerning design have been made. When the highway project has been completed, appropriate revisions will be made to the study report and maps.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long-term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect

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Table 1. Major Floods Affecting Richfield

Date	Location	Peak Flow (cfs)	Return Period (years)
1896 July 14-17	Cottonwood Creek		
1901 August 3	Cottonwood Creek		
1905 August 25	Cottonwood Creek	1,500	12.5
1909 August 10	West Canyons		
1913 August 9	West Canyons		
1916 July 4	Cottonwood Creek		
1929 August 27	Cottonwood Creek		
1930 August 13	Local rains		
1930 September 6	West Canyons		
1931 July 30	West Canyons		
1934 August 19	Cottonwood Creek	950	6.2
1935 July 11	Cottonwood Creek	750	4.5
1936 July 31	Cottonwood Creek	125	2
	West Canyons		
1937	Cottonwood Creek	800	5
1938	Cottonwood Creek	1,000	6.7
1939	Cottonwood Creek	870	5.6
1940	Cottonwood Creek	500	3.0
1943	Cottonwood Creek	700	4.2
1944	Cottonwood Creek	650	3.8
1946 August 22	Cottonwood Creek	135	2
1961 July 31	Cottonwood Creek	2,000	21
1961 August 11	Cottonwood Creek	175	2
1965 August 1	Cottonwood Creek		
1967 July 23-24	West Canyons		
1967 August 6	Cottonwood Creek	5,180	250
1967 September 5	Cottonwood Creek		
1967 September 22-25	Cottonwood Creek		
1968 July 24	West Canyons		
1968 July 30	Cottonwood Creek		
1968 August 5	Cottonwood Creek		
1968 August 8	Cottonwood Creek		
1971 July 25	Cottonwood Creek		
1972 June 8	Dairy Canyon		
1975 July 4	West Canyons		
1976 July 17	Cottonwood, Dairy		
1977 July 23	Cottonwood, Dairy		
1981 July 10	Cottonwood, Dairy		
1981 September 10	Cottonwood		
1983 May 25	Cottonwood		
1983 May	Cottonwood		

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flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each flooding source studied in detail affecting the community.

Both Cottonwood Creek and Dairy Canyon are ungaged, intermittent streams. The SCS derived flood-frequency estimates for both these streams using the SCS Curve Number and Unit Hydrograph Procedure (Reference 4). Their analysis was reviewed in light of available historical data and was felt to be reasonable and valid. Therefore, the peak discharges adopted for use in this Flood Insurance Study for the 10-, 50-, and 100-year floods are those computed by the SCS. The peak discharge estimates include a sediment bulking factor to account for the large amount of sediment and debris which is carried with the floods.

The 500-year peak discharges were estimated through extrapolation of the clear-water frequency curve using the log-Pearson Type III distribution with a regional skew of -0.1. The effect of sediment was then included through the use of a bulking factor for each stream.

Peak discharge-drainage area relationships for Cottonwood Creek and Dairy Canyon are shown in Table 2.

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Hydraulic analysis of Cottonwood Creek at the Sevier Valley-Piute Canal revealed that the channel would convey a maximum flow of 850 cfs as a result of entrance constrictions from the culvert and over-chute structure. The backwater analysis for the lower portion of Cottonwood Creek was based on this flow. The remaining flow would be intercepted by the canal and would most likely cause the canal to breach at some point. This flow would spread over the land below the breach and cause shallow flooding problems.

Cross sections for the backwater analyses on the lower portion of Cottonwood Creek below the Sevier Valley-Piute Canal were obtained through actual field surveys.

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Table 2. Summary of Discharges

Flooding Source and Location	Drainage Area (Square Miles)	Peak Discharges (cfs) 10-Year	50-Year	100-Year	500-Year
Cottonwood Creek					
At Canyon Mouth	20.00	1,300	2,925	3,745	6,455
Dairy Canyon					
At Canyon Mouth	2.42	640	1,400	1,735	2,900

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Roughness factors (Manning's "n") used in the hydraulic computations were chosen by engineering judgment and based on field observations of the streams and flood plain areas. Roughness values for the main channel of Cottonwood Creek ranged from 0.013 to 0.045, while flood plain roughness values ranged from 0.035 to 0.050 for all floods.

Water-surface elevations were computed through the use of the COE HEC-2 step-backwater computer program (Reference 5). Because the backwater analysis indicated that the flow of 850 cfs would be contained within the channel banks, no flood profiles for Cottonwood Creek were prepared for this study since this maximum flow does not create any flood hazards to the city.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

Flood plain boundaries and flood depths for areas above the Sevier Valley-Piute Canal for both Dairy Canyon and Cottonwood Creek were determined using alluvial fan methods. Below the canal, shallow flooding depths were determined using normal depth calculations and a comparison of historical flooding from these drainages. The shallow flooding boundaries below the canal were determined from the alluvial fan boundaries.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study produces maps designed to assist communities in developing flood plain management measures.

4.1 Flood Boundaries

To provide a national standard without regional discrimination, the 1-percent annual chance (100-year) flood has been adopted by FEMA as the base flood for flood plain management purposes. The 100-year flood plain boundaries have been delineated using the topographic maps at a scale of 1:4,800, with a contour interval of 4 feet (Reference 6).

Flood plain boundaries are indicated on the Flood Insurance Rate Map (Exhibit 1). On this map, the 100-year flood plain boundary

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corresponds to the boundary of the area of special flood hazards (Zone AO).

4.2 Floodways

The floodway is the channel of a stream, plus any adjacent flood plain areas that must be kept free of encroachment so that the 100-year flood may be carried without substantial increase in flood heights.

A floodway was computed for Cottonwood Creek but is not shown because the flow of 850 cfs would be contained within the channel banks. The concept of a floodway is not applicable for shallow flooding areas or alluvial fans.

5.0 INSURANCE APPLICATION

To establish actuarial insurance rates, data from the engineering study must be transformed into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors, and flood insurance zone designations for each flooding source studied in detail affecting the City of Richfield, Utah.

5.1 Reach Determinations

Because flooding is shallow or on alluvial fans in Richfield, the area does not lend itself to standard reach determinations as defined by FEMA. Consequently, none were developed in these areas, and flood insurance zones were assigned directly based on the type of flooding conditions in the community.

5.2 Flood Hazard Factors

The Flood Hazard Factor (FHF) is used to establish relationships between depth and frequency of flooding in any reach. This relationship is then used with depth-damage relationships for various classes of structures to establish actuarial insurance rate tables.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations rounded to the nearest one-half foot, multiplied by 10, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10-and 100-year flood water-surface elevations is greater than 10.0 feet, it is rounded to the nearest whole foot.

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FHFs are not applicable for areas of shallow flooding or alluvial fans; therefore, no FHFs were computed for Richfield.

5.3 Flood Insurance Zones

Flood insurance zones and zone numbers are assigned based on the type of flood hazard and the FHF, respectively. A unique zone number is associated with each possible FHF, and varies from 1 for an FHF of 005 to a maximum of 30 for an FHF of 200 or greater.

Zone A0:	Special Flood Hazard Areas inundated by types of 100-year shallow flooding where depths are between 1.0 and 3.0 feet; depths are shown, but no FHFs are determined.
Zone B:	Areas between the Special Flood Hazard Areas and the limits of the 500-year flood; areas that are protected from the 100- or 500-year floods by dike, levee, or other local water-control structure; areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.
Zone C:	Areas of minimal flood hazard; not subdivided.

The flood elevation differences, FHFs, flood insurance zones, and base flood elevations for each flooding source studied in detail in the community are summarized in Table 3.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the City of Richfield is, for insurance purposes, the principal product of the Flood Insurance Study. This map contains the official delineation of flood insurance zones and base flood elevations. Base flood elevation lines show the locations of the expected whole-foot water-surface elevation of the base (100-year) flood. The base flood elevations and zone numbers are used by insurance agents, in conjunction with structure elevations and characteristics, to assign actuarial insurance rates to structures and contents insured under the NFIP.

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6.0 OTHER STUDIES

A number of flood-related studies of the Richfield area have been conducted due to the relatively frequent flooding that occurs. Many of the floods that occurred in the Richfield area since 1896 have been documented (Reference 7).

The U.S. Forest Service has implemented range management measures to control erosion and reduce runoff in the upper portion of the Cottonwood Creek watershed. In the 1970s, the SCS conducted preliminary and feasibility investigations for flood prevention and control for the watersheds in the Richfield area (References 1 and 2). The feasibility investigations proposed flood-control structures for several of the canyons affecting Richfield; however, project costs were excessive and the structures have never been built.

The SCS published a report in April 1977 that evaluates and identifies flood hazards in the Richfield area and delineates the areas affected (Reference 7). Much of this information was used in a concurrent study conducted by Schick International, Inc., for the Utah State Soil Conservation Commission (Reference 3) that proposed flood-control structures for the canyons affecting Richfield. These structures have not been built.

Because of its more detailed analysis, this Flood Insurance Study supersedes the previously published Flood Hazard Boundary Map for the City of Richfield (Reference 8).

7.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, FEMA, Building 710, Denver Federal Center, Lakewood, Colorado 80225.

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